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Revised Sediment Budget of the North-Alpine Foreland Basin and the Role of Erosional Recycling: Did Erosion Rates Change at 5 Million Years?

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The fundamental discussion of whether or not climate change triggered a global acceleration of erosion at 5 Ma is widely based on volumetric estimates of eroded material in sedimentary basins. The sediment budget of the Alps is one of the most striking data sets in the world apparently recording a substantial increase in sediment discharge over the past $\sim$ 5 Ma. Recently, however, this increase has been challenged by the argument that it may reflect an artefact due to observation and measurement biases. We therefore re-assessed the sediment-budget dataset by considering the effects of erosional recycling of previously deposited Alpine detritus. We found that from $\sim$ 34 – 5 Ma eroded Alpine material was deposited in proximal basins such as the north-Alpine foreland basin, whereas from $\sim$ 5 – 0 Ma most of the sediments were mainly deposited in distal basins such as the North Sea and the Black Sea. During the last 5 – 10 Ma, the north-Alpine foreland basin was uplifted by several hundred meters as indicated by subsidence curves, and stratigraphic as well as apatite fission-track data document its erosion implying a significant increase of the potential erosion area. The original erosion area of 20 000 km^2 calculated by Kuhlemann et al. (2000) for the Western Alps increases to ca. 28 000 km^2 when the area of the adjacent eroded foreland basin, the Swiss portion, is included. Similarly, the erosion area of the Eastern Alps increases to c. 71 500 km^2 by including the German-Austrian portion of the foreland basin. However, for the Po and Pannonian basins adjacent to the southern and eastern borders of the Alps, such a late phase of uplift and erosion has not been documented. Accordingly, we re-calculated the Alpine erosional history based on the adjusted erosional areas, which resulted in a nearly constant Alpine sediment yield since before 5 Ma. The recycling of Alpine deposits from the north-Alpine foreland basin since 5 Ma contributed significantly to the overall distal increase in sediment discharge. Our findings require tectonically-driven uplift of the Alps and its foreland basin since 5 Ma. We thus challenge recently published views that climate change accelerated the erosion of high mountainous areas since 5 Ma. We propose that models invoking climatically-triggered isostatic rebound of the Alps since 5 Ma need to be revised in light of the effects of erosional recycling of previously deposited material explained above.